

**QUARTERLY PROGRESS REPORT**

**DRD 875MA-003**

**January 2004 - March 2004**

**Marshall Space Flight Center  
Safety and Mission Assurance Mission Services Contract  
NAS8-00179**

**Approved:**

**Original Signed By:**

A handwritten signature in black ink, appearing to read 'Randall S. Reed', is written over a horizontal line.

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**April 9, 2004**

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## **1.0 INTRODUCTION**

Hernandez Engineering, Inc. (HEI) successfully performed all required activities and tasks, as described in this report, in fulfillment of their Safety and Mission Assurance (S&MA) Mission Services Contract (NAS8-00179) with NASA's Marshall Space Flight Center (MSFC). This report covers a three-month period of the contract's second quarter of the third option year: January 2004 through March 2004.

## **2.0 GENERAL MANAGEMENT**

### **2.1 Data Requirements**

The second quarter of the third option year of the S&MA Mission Services contract was successfully completed on March 28, 2004. All Data Requirements (DR) Documents were submitted on or ahead of schedule throughout the quarter. They included DRD 875CD-001 On-Site Employee Location Listing; DRD 875MA-002 Financial Management Reports; DRD 875MA-003 Progress Reports (Monthly/ Quarterly); DRD 875MA-006 Operations Plan, Problem Assessment Center (PAC); DRD 875MA-007 Quarterly Open Problems List; DRD 875MA-008 Monthly Newly Opened/Closed Problem Summary; DRD 875SA-002 Mishap and Safety Statistics Reports; and Quarterly Safety Performance Evaluation.

### **2.2 Personnel Status**

(b)(4)

## **3.0 BUSINESS MANAGEMENT**

We have experienced no financial or business management problems during this period. We attribute this to close attention to details, effective use of established controls designed to efficiently respond to program changes---both anticipated and unexpected---and the continuing support of our corporate financial group's dedicated efforts at controlling overhead expenses.

The contract continues to have a total cost under-run at the end of this period---see the March 2004 Monthly Financial Report, DRD 875MA-002, for specifics. Attachment 2, Man-Hours Expended, of this report contains a description, by major task, of the total man-hours expended this period.

(b)(4)

## **4.0 PERFORMANCE OF WORK AND USE OF FACILITIES AND EQUIPMENT**

### **4.1 Safety**

#### **4.1.1 Industrial Safety (IS)**

The Industrial Safety (IS) group initiated the CY04 OSHA compliance annual facilities inspections, performed 100 OSHA compliance annual facilities inspections and provided all

required reports in a timely manner. Also, IS performed 475 construction site compliance inspections to monitor adherence to OSHA and MSFC safety standards. All facility safety violations were documented in the SHEtrak database in order to assure MSFC's compliance with OSHA, NASA, and other consensus code requirements.

Among other activities, IS: 1) participated in two pre-construction conferences; 2) participated in 19 final safety inspections of facilities under renovation or construction; 3) reviewed 74 sets of facility design drawings for compliance with OSHA and consensus codes; 4) assisted the Industrial Safety Department (ISD) develop and process, for web page posting, three Safety Bulletins and two Shop Talk safety information topics; and, 5) performed one periodic fire drill.

Although not a designated contract year Area of Emphasis (AOE), IS agreed to continue the emphasis to increase awareness of identifying Unsafe Acts in the workforce. IS identified nine Unsafe Acts with emphasis on on-the-spot corrections. To assist in this effort HEI continued to provide (b) (4) to assist the ISD identify Unsafe Acts. In addition, this same (b) (4) surveyed 307 locations to assure adherence to Lockout/Tagout requirements when working on energized systems and monitored construction and maintenance activities after normal work hours and weekends.

IS continued to provide (b) (4) to assist the SHE Communications and Training Teams and general communication of safety awareness to all MSFC employees. Assistance included: 1) prepared and processed, for web page posting, the weekly SHE highlights and monthly SSWP safety required and optional focus topics; 2) prepared monthly SHE communications plans; 3) developed multiple innovative safety awareness communications materials including safety announcements on MSFC TV; and, 4) on a voluntary basis, IS continued to assist the SHE Committee Chairperson and ISD support bimonthly SHE Committee meetings, including collection and organization of pre-meeting briefing charts, serving as recorder and preparing draft meeting minutes.

IS initiated, completed or followed-up on more than 12 hazard analyses. Examples include: 1) completed a Safety Assessment (SA) for the Solar Thermal Technology Testing at TS 500; 2) prepared engineering notes for the Real Time Radiography (RTR) of Solid Fuel Torch Test in Test Cell 104, building 4583; 3) completed a SA for the Water/Nitrogen Spray Characterization Testing (WNIST) in building 4583; 4) initiated an Operational Hazard Analysis (OHA) for the Orbiter Boom System (OBSS)/Inspection Boom Assembly (IBA) transportation and handling operations at MSFC; 5) continued to support the 24-Inch SRTM-XL Motor Firing at the PESSTS Test position; 6) reviewed restrictions for operating the Global Electric Motorcars (GEM) on MSFC and Redstone Arsenal roadways with posted speed limits greater than 35 MPH; and, 7) continued to perform a SA for the new high visibility Propulsion Research Laboratory (PRL), scheduled for occupancy in 04/04.

IS continued to support the implementation of the NASA lifting standard, NASA-STD-8719.9 by providing day-to-day advice and assistance to S&MA customers. IS advised civil service and contractor managers, supervisors and employees on requirements for lifting equipment usage in support of the MSFC SHE Program. In addition to performing an OHA to support OBSS/IBA testing in building 4619, HEI initiated a FMEA for the overhead crane to be used during testing

activities and was involved in multiple planning meetings associated with the OBSS/IBA. Also, IS continued to be an active participant in the Lifting Device Equipment (LDE) SHE subcommittee. In support of the task to administer proficiency exams to civil service and contractor operators of overhead cranes, fork lifts, small truck mounted hoists, and aerial lifts, IS administered hands-on proficiency examinations to 41 overhead crane, 25 forklift, and 4 aerial lift operators in support of the MSFC Personnel Certification Program.

As a continued significant strength, IS continued to provide dedicated, full-time safety and quality support to the MSFC Test areas. Examples of support included: (1) reviewed and approved multiple operating and test procedures for hazardous operations; (2) continued to review Quantity Distance (QD) requirements for the KT-Engineering, 24-Inch Motor Slump & Composite LOX tank at TS500; (3) reviewed QD requirements for the SSME LAI Testing on the Liquid Hydrogen SSME Pump at building 4626; (4) as an additional duty, served as the alternate safety representative for test area facilities; and, (5) provided daily support to test engineers and S&MA personnel on technical issues to include performing numerous test procedure reviews.

#### **4.1.2 System Safety Engineering**

System Safety Engineering (SSE) completed significant changes to the "OSP Methodology for Conduct of Hazard Analysis" document, (OSP-PLAN-XX), including review and incorporation of accepted comments from other NASA Centers. The completed document was submitted to QD10 for baseline on 03/25/04, as a stepping off point for the Code T review/development for the CEV program.

SSE participated in four (4) telecons, table-top reviews and submitted changes to Volume 1 and Volume 2 of the study results. The initial release of the "final" version of Volume 1 for program (OSP and ELV teams) review and comment was 03/01/04. Many managers positively commented about the team's efforts and the leadership of the Chairman during the 03/19/04, Team Chairman's briefing to the OSP/LSP Program Managers.

SSE developed and revised a charter for the OSP SSWG. The SSWG's purpose would be to coordinate NASA wide safety issues for the OSP program and provide unified answers to contractor concerns, coordinate safety definitions and elevate issues as necessary. The OSP SSWG charter, as revised, was accepted by QS10.

SSE supported the collection of OSP Lessons Learned for the Program. SSE has submitted multiple lessons focusing on early involvement of S&MA, coordination across NASA Centers and development of S&MA requirements.

SSE participated in the X-37 Approach and Landing Test Vehicle (ALTV) System Safety Working Group (SSWG) meetings conducted on 01/21/04, 02/25/04 and 03/11/04. SSE supported the consolidation of ALTV hazard reports including the reassessment of hazard severity and likelihood for the combined reports. The SSWG reviewed and approved the B-52/X-37 Integrated and Drogue Chute Hazard Reports, reviewed the generic hazard reports developed for the B-52 and the test vehicle pylon, and discussed the apparent disconnect between the generated hazard analyses and the use of procedural controls in likelihood assessment.

SSE participated a X-37 Flight Termination System (FTS) Structural Design TIM on 02/24/04. Boeing presented an overview of the current FTS design. Several structural issues were identified during the TIM. However, the identified issues were either resolved or agreements on actions to resolve outstanding issues were accepted during the 03/30/04 Critical Design Review (CDR).

System Safety Engineering (SSE) reviewed and submitted comments on 03/12/04 to the ETT GR&A document for concept definition and evaluation of HLLV concepts. Comments included reference to NASA-STD-5001, rationale for inclusion of fault tolerance for major sub-systems and mission impact of a single-engine-out failure. As a result of another comment, SSE also submitted a checklist of design driving EWR 127-1 requirements to allow various HLLV concepts to be compared to a baseline set of assumed requirements instead of comparing all concepts to each other on 03/15/04.

SSE participated in the Hy-TE<sub>x</sub> PDR by reviewing submitted the risk management plan and Preliminary Hazard Analysis. SSE entered RIDs against both documents stating that the documents were not sufficiently mature. SSE identified those areas of the documents that are missing or need significant improvement.

SSE participated in a review of the "JIMO RM Plan" and provided comments to the Project Assurance (OA) Lead for inclusion and clarification of SSE responsibilities in RM for the JIMO program.

SSE participated in the Human Exploration and Development of Space course held at NASA HQ in Washington, D.C. The course focused on how to derive an initial mission design and trade different mission concepts. The course provided a wealth of reference information and specifics on environments including microgravity, lunar, and Mars environments and how they impact design choices.

SSE supported a broad range of ET, RSRM, SRB and SSME RTF activities which focused on reviewing and updating hazard analyses, risk analyses, reviewing FMEA/CILs and proposed changes and obtaining approval of updated Hazard Reports.

SSE supported the ET Bi-Pod CDR and Delta CDR, the Bi-Pod Heater Acceptance and Qualification Test, The Protuberance Air Load (PAL) Ramp, the Bi-Pod Fitting to Bolt Preload Test, the Liquid O<sub>2</sub> Feed line Support Component Test and many Technical Interchange Meetings. In addition to developing a Loss of TPS Fault Tree Analysis SSE has directed activities which resulted in approval of two (2) ET Hazard Reports and significant updates to many others.

Specific RSRM RTF activities supported by SSE include the Propellant Preliminary Design Review and detailed review of existing Waivers, Deviations, and Exceptions for two RSRM Work Centers.

SSE support to the SSME RTF activities focused on participation in re-evaluations of hazard reports, FMEA/CILs and proposed changes. The evaluation discussions were held at either the

Boeing-Rocketdyne facility or by telecon and have resulted in completion of the initial review of all SSME "Accepted Risk" hazard reports.

SSE supported SRB Thrust Vector Control issue resolution including Gas Generator Injector Stem issues and participated in the SRB Bolt Catcher Review, the Altitude Switch Assembly Certificate of Qualification, and the Hold-Down Stud Problem Investigation.

SSE participated in four (4) SSRP telecons beginning on 02/11/04. During the first telecon, the major item of discussion was a draft up-date of Integrated Hazard Report INTG-015. The chairman deferred consideration of the HR until comments are incorporated into the report. In following telecons, the ET GH2 Pressure Transducer FMEA/CIL updates and the update of Hazard Report S.09, Hydrogen Venting in Flight were both accepted. Also, the potential Orbiter/Station safety concern driven by the remote possibility for an inadvertent orbiter RCS firing when attached to the ISS was addressed. The last meeting focused on the RSRM Project's proposed closure of the STS-107 IFA (RH Nozzle Flex Boot Separation). The RSRM team also presented the initial assessment of impacts to the related Hazard Report and CILs. The panel concurred in the proposed closure and requested to be kept informed on the updates to the hazard report and CILs.

SSE participated in four (4) telecons to discuss and review draft charter updates for the three current panels (PSRP, SRP and SSRP), and two new panels: the SSP Reliability and Maintainability panel and a SSRP and SRP sub-teams. The sub-team discussed the pros and cons of merging the shuttle and station panels. The opinion of the team was that the SRP and SSRP could not be effectively merged now but should endeavor to work toward similar processes and requirements to allow future integration. SSE provided QS20 management a summary of the proposed changes in the SSRP charter and offered 5 points for consideration in assessing the drafts.

SSE and other S&MA disciplines (Reliability, Risk Management and Quality Engineering) met with the MSFC RCC Repair Project Manager to organize S&MA support. SSE and Risk Management are supporting the project as required to support an April KC-135 flight and possible hardware delivery to KSC in 12/04.

Payload Safety Engineering (PSE) continues to support NODE 2 and NODE 3 by daily participation in project meetings, reviewing engineering and requirement changes, proposed testing and verification closures. Additionally, PSE supported NODE 2 by resolving actions issued at the Phase II Flight review and updating the Hazard Reports including the Safety Verification Tracking Log with additional Verification Closure Notices (VCNs) and Operational Control Agreement Document (OCAD) verifications. At this time verifications in reports Node 2-0001 thru Node 2-0004 have been closed (approximately 80 verifications), with the exception of the verification concerning Fracture control of the Node 2 pressure shell.

PSE supported a telecon to discuss the Non-Destructive Evaluation (NDE) of the Nodes. The Node 2 had no NDE performed post-proof pressure testing on the welds; it was done pre-proof pressure testing only, and this method was approved by JSC structures and ISS management. Post Columbia reviews have determined that this may have been a wrong decision and

investigations and meetings are being held to determine what kind of NDE should now be performed on Node 2 pressure shell welds. Node 3 will have a complete post-proof NDE performed on all pressure shell welds.

Payload Safety Engineering (PSE) support to the NODE 3 Project included participation in meetings and evaluating the effect of US lab cooling loops and its effect on the critical items, evaluating proposed changes and the effect upon existing hazards, updating Phase II Flight Hazard Reports for resubmission. PSE supported the related Oxygen Generation System (OGS) by working Valve Position Indicator issue, providing requirements for electrical shock hazard controls, participation in Physical Configuration Audit (PCA) and updating the verifications. SSE participation in the Water Recovery System (WRS) included reviewing verification data packages, test procedures, addressing Quick Disconnect (QD) failure concerns and continued to update hazard analyses and reports.

Payload Safety Engineering (PSE) supported the MPLM Programmable Thermostat design by participating in meetings, reviewing Program Interface Revision Notices (PIRNs), Space Station Change Notices (SSCN), closing safety verifications and updating hazard reports including Safety Verification Tracking Log (SVTL).

Payload Safety Engineering continues updating the GBM Safety and Mission Assurance Plan based on comments from both the project and new information obtained by payload safety.

Payload Safety Engineering (PSE) supported the Biological Research Project (BRP) at the successful BRP Phase III Safety Review with the PSRP at JSC. The BRP had 11 out of 13 hazard reports signed with only three (3) actions assigned. SSE also provided SSP 30233 to the Problem Reporting and Corrective Actions (PRACA) group for review, met with the Defense Contracts Management Association (DCMA) submitting comments to the Phase III Flight Safety Data Package (FSDP) and assisted in resolution of two waiver issues.

Payload Safety Engineering (PSE) supported a number of activities related to the Microgravity Science Glovebox (MSG) during this period. PSE submitted and obtained approval by the PSRP of the Phase III Safety Data Package (SDP) for the integration of Dutch Soyuz Mission (DSM) with MSG on 01/22/04, the MSG Orbital Replacement Units (ORUs), and the successful MSG 8S Flight Certification Review (FCR) on 03/01/04. PSE provided input to the Safety Certification extension and submitted comments regarding a draft proposal for testing limited life items in orbit instead of replacing them automatically by date. PSE will present this to the PSRP on 05/13/04.

Payload Safety Engineering (PSE) reviewed and approved procedures for removing and adjusting a gear assembly in the PFMI hardware on-orbit after the associated gear train stuck. By using these procedures the astronaut enabled the gear train to work as required, and PFMI has resumed processing its samples. The consequent on-board operations proceeded successfully. The PSE also assisted in closing all Acute Launch Emergency Restraint Tips (ALERTs) that applied to PFMI.

Payload Safety Engineering (PSE) supported the Delta-L/Single-Locker Thermal Enclosure System (STES)/MSG integration activities by performing hazard analyses, developing a strategy to address touch temperature issues, updating Hazard Reports and the Safety Verification Logs, preparing slides for the PSRP Phase III integrated review, and participation in the successful integrated review on 02/17/04 at JSC. PSE support included integrated analyses including the utilization g-LIMIT inside the MSG work volume for the Delta-L integrated review.

PSE developed the reflight SDP for the InSPACE-2/MSG integration and assisted in supporting a Verification Control Board for OPCGA.

Payload Safety Engineering assisted with the investigation and discussion of the MSRR-1 Fairchild fastener issue in the absence of the acting S&MA Lead. PSE is working with the affected groups to determine the extent of the problem, and what steps need to be taken to resolve it.

PSE provided S&MA Lead support in the process of shipping QMI ground and flight parts to TBE as part of the Systems Development & Operational Support (SDOS) contract. PSE continues to work with NASA and TBE representatives to ensure hardware is shipped per the SDOS contract and Letter of Delegation. The scope of work is under reevaluation per the recent directive that QMI funding will cease at the end of the fiscal year.

PSE supported the Gravitational Effects on Distortion on Sintering (GEDS) Project by attending meetings, providing information to the JSC toxicologist, and providing the analyses results to the team. The JSC toxicologist rated the GEDS samples as toxicity rating of four (4) at processing temperature – related to metal fumes; which is an issue of concern. The rating could cause a major redesign of the GEDS Sample Ampoule Cartridge Assemblies (SACAs) to allow processing in the Low Gradient Furnace (LGF). GEDS has been designing hardware based on a toxicity rating of zero (0), which is only valid for one sample, not seven as are used in a typical run.

PSE reviewed an Engineering Change Request against NSTS 1700.7 to add evaluation of materials specifically for biological hazards. SSE suggested approval with modification. The rationale is to exclude any pressure vessel with relief mechanisms from containing biological material.

SSE participated in preparation of standard DRDs for the HA, FTA, and System Safety Plan which were submitted on 02/27/04 and were released to internal S&MA for review by 03/01/04. SSE received comments and submitted updates on 03/31/04.

## **4.2 Reliability**

### **4.2.1 Reliability & Maintainability Engineering (R&ME)**

In support of the Advanced Projects Assurance Department, Reliability and Maintainability Engineering (R&ME) continued providing R&M discipline support to the Orbital Space Plane (OSP) and Next Generation Launch Technology (NGLT) programs. R&ME continued to lead the OSP RMS Working Group to identify and resolve R&M related issues with the OSP

architecture contractors. R&ME participated in the System Definition Reviews (SDRs) for both Boeing and Lockheed-Martin, reviewed and provided feedback on the SDR deliverables, and held several splinter meetings with the contractor RMS personnel to coordinate issues. Since the termination of the OSP program, R&ME has participated in the ongoing lessons learned effort to ensure that R&M related lessons learned that will be of benefit to future programs are appropriately captured. R&ME participated as a member of the OSP/ELV Human Flight Safety Certification Team, which was chartered by the OSP program manager to provide an assessment of the capability to human-rate the current Evolved Expendable Launch Vehicle (EELV) for use by the OSP program. R&ME provided substantial inputs to the study, including reliability analyses to help determine the feasibility of meeting the 1/400 probability of Loss of Crew requirement using the current EELVs, and identification of gaps in the current EELV safety and reliability processes. R&ME participated in the X-37 Approach and Landing Test Vehicle (ALTV) FMEA/CIL Tiger Team, including compilation of Tiger Team comments, coordination of issues with Boeing, and presentation of the results to the X-37 Technical Review Board. In support of NGLT, R&ME has been an active participant in the NGLT Life Cycle Analysis Team (LCAT) and Organization Discipline Team. R&ME also continued supporting the Jovian Icy Moon Orbiter (JIMO) project, and is currently developing and coordinating fault tree analysis for a number of the JIMO subsystems, and began the effort to integrate the subsystem fault trees into a system level fault tree. R&ME also supported the Exploration Task Team (ETT) activities, including providing qualitative risk assessments and Mission Success calculations for the various Heavy Lift Launch Vehicle configurations that are being studied.

In support of the Shuttle Assurance Department, R&ME is currently actively involved in Return to Flight (RTF) activities for all of the propulsion elements, including review and update of CIL retention rationale and accepted risk hazard reports. R&ME is participating in the ET RTF effort for the Feedline Bellows redesign and Enhanced Launch Vehicle Imaging System, and made numerous trips to the Michoud Assembly Facility to participate in team meetings, reviews, and test activities associated with these redesign efforts. R&ME also participated in the ET Bipod delta Critical Design Review. R&ME continued to support ongoing effort related to Shuttle Upgrades, including active participation in the qualification process for the Solid Rocket Booster (SRB) Integrated Electronics Assembly (IEA) wire harness upgrade. R&ME participated as a member of a team that went to Labarge, manufacturer of the IEA wire harnesses, to review and approve critical processes and procedures that are used in the IEA harness replacement upgrade. R&ME participated in the Reusable Solid Rocket Motor (RSRM) Propellant Grain Redesign Preliminary Design Review (PDR) and Nozzle Joint 2 Carbon Fiber Rope Critical Design Review (CDR), and reviewed Thiokol's System Safety/Reliability assessment and methodology to determine the risks, hazards and failures associated with the design, hardware and process changes. The R&ME Supervisor was designated by QS20 to serve as the MSFC focal for the newly established Space Shuttle Reliability & Maintainability (R&M) Panel, which has been chartered to assure the implementation of the SSP R&M programmatic and technical requirements across all Shuttle program elements.

In support of the Cargo Assurance Department, R&ME continued incorporating feedback received from ISS R&M into the Node 3 FMEA/CIL and has completed and resubmitted worksheets for 4 of the 6 Node 3 subsystems, the remaining subsystems are on track for completion. R&ME was asked to prepare a white paper for the Extreme Universe Science

Observatory (EUSO) project to establish a reasonable mission reliability requirement for the EUSO and a preliminary reliability allocation to the subsystems and components to help influence the conceptual design of the instrument. R&ME also supported the Gravity Probe-B Flight Readiness Review and Independent Mission Assurance Review, and supported assessment and resolution of a late-breaking issue regarding the reliability of the GP-B sunshade shutter mechanism.

#### **4.2.2 Problem Assessment Center Operations**

HEI's Problem Assessment Center (PAC) personnel processed and coordinated disposition of problem reports, coordinated the MSFC Problem Assessment System, supported various redesign and return-to-flight activities, participated in the STS-114 countdown simulation, and operated the Corrective Action System (CAS). The PAC received and entered 32 new problem report (PR) into MSFC's Problem Reporting and Corrective Action (PRACA) System, coordinated MSFC interim closure of 15 PRs, received 7 prime contractor closure recommendations, supported MSFC full closure of 9 PRs, coordinated non-problem closure of 11 problems, and performed 225 individual PR database updates and reviews. PAC conducted 5 SSME problem review boards (PRBs) resulting in dispositioning 25 of 25 problem reports presented and statusing 4 PRs. The PAC generated or updated trends for MSFC Shuttle problems submitted as newly opened or for closure. PAC also generated and distributed monthly problem bubble trend risk charts and briefed the charts at the monthly SRB Problem Assessment System (PAS) review. PAC reviewed 5 requests for access to the MSFC PRACA database and granted 5 of them.

In support of return-to-flight, PAC coordinated MSFC's review and impact of proposed changes S062082A and S062082B to NSTS 08126, Space Shuttle Problem Reporting and Corrective Action (PRACA) System Requirements. This included participating in 4 Rewrite Team teleconferences, coordinating MSFC Shuttle and prime contractor participation in them, and circulating results of the meetings. It also included evaluating the proposed changes, circulating these evaluations among MSFC-related participants, reviewing and discussing contractor-submitted evaluations and recommendations, and presenting evaluations at the meetings. All of these activities were coordinated by the PAC with the various MSFC Shuttle Project Offices, S&MA Shuttle Integration, and the MSFC Shuttle prime hardware contractors. PAC also have been performing SSME Data Mining for Periodic/Episodic/Repeating Problems, providing, reviewing, and organizing data from the MSFC PRACA, KSC PRACA data systems, Stennis Reliability Analysis and Maintainability System (RAMS), and Rocketdyne problem data systems. Furthermore, PAC evaluated proposed revisions of the RSRM problem reporting implementation plan and represented S&MA on the SSME HPFTP Liquid Air Insulation (LAI) redesign team.

In problem system coordination, the PAC conducted 3 SRB Problem Assessment System (PAS) status review for the SRB Chief Engineer, developed Draft 4 of the OSP PRACA Requirements document, circulated it for review, obtained and incorporated response inputs, and submitted the final document as a methodology for OSP DCB approval upon the advice of OSP Configuration Management. PAC also reviewed, red-lined, and formatted the standard Data Requirements Definition for PRACA.

The PAC provided various problem data in support of NASA and MSFC analyses. Regular activities included providing daily KSC PRACA shuttle problem summaries, daily MSFC PRACA open-against-next-mission summaries, daily KSC Resident Office reports, monthly newly opened/closed problem summaries, weekly SRB PRACA and ALERT activities and status reports, and quarterly Open Problems List (OPL). Special activities included: (1) extracting and providing problem histories on Gulton LH2/LO2 ET pressure transducers; (2) extracting, formatting, and providing SSME problem histories on main combustion chamber welds, nozzle tube failures, Block II controller, nozzle jacket missing pieces, single tube heat exchange damage, and loss of nozzle ablative; (3) providing a list of Orbiter wire shorts and arc tracking; (4) and extracting and providing SRB amphenol connector problems from MSFC and KSC PRACAs.

In problem trending, PAC generated regular problem entry and disposition problem histories; issued monthly bubble trend charts with interpretations of data; and provided, explained, and answered questions regarding MSFC trending to NESC representatives.

In implementation and operation of the MSFC Corrective Action System (CAS), PAC received 20 potential CAS reports, screened 20 draft Recurrence Control Action Requests. PAC also provided and discussed CAS metrics and open RCAR status reports at the Marshall Management System (MMS) Implementation Team meeting, and issued monthly RCAR status and delinquent response reports. PAC was surveyed by the S&MA internal auditors, with neither observations nor discrepancies being charged. PAC also discussed needed changes to the CAS system to fully incorporate Customer Feedback into automated RCAR flow, advised on implementation concepts, and reviewed preliminary implementations.

#### **4.2.3 ALERT Program**

HEI's ALERT support included both regular and special activities as HEI coordinated MSFC ALERT processing. HEI received and distributed 23 ALERT announcements for MSFC review and obtained 1,005 responses from MSFC project, contractor, and laboratory contacts. We also provided notification, assistance, and support contributing to reducing the delinquent ALERT response count from 738 on 12/31/2003 to 323 on 3/31/2004. HEI ALERT support personnel 1) reviewed and approved 6 new MSFC ALERT database accounts via the TPS security; 2) generated monthly Open, Delinquent ALERT response tabulations and provided them to S&MA and/or Directorate single points-of-contact responsible for open ALERT reduction; 3) reviewed and red-lined changes to the GIDEP Operations Manual and NASA's NPR 8735.1; 4) assisted processing of ALERTs by the MSFC projects and directorates; 5) assisted development, coordinated review, and/or released MSFC-generated ALERTs on solder iron tip overheating and timing irregularities on SuMMIT's digital microcircuit SKIP command; 6) researched and informed involved organizations on a GP-B transponder diplexer issue from GSFP and on an anonymous warning to SSME regarding invalid HydraForm documentation; and 7) participated as secretary at the GIDEP Industry Advisory Group business meeting at San Antonio, TX.

### 4.3 Quality

#### Space Transportation

External Tank (ET) Quality Engineering (QE) attended an ET Project Leadership Off-Site and participated in team building and project management activities. ET Quality Engineering also participated in a certification documentation review at Michoud Assembly Facility to review the proposed revised certification documents and the new data system being implemented for RTF certification acceptance. ET Quality Engineering continued to review numerous test plans and procedures for development and certification tests conducted for RTF activities. In addition, ET QE continued day-to-day activities which included participating in the monthly ET Quality Escape telecons and preparing the Quality Escape Reports, participating in the ET TPS Working Group, participating in Composite Nose Cone team meetings and reviewing test plans for demonstrating high temperature performance of the material and participating in the Space Shuttle Program Quality Panel.

QE participated in ET RTF activities which have included the review and evaluation of nonconformance documents for ET Serial Numbers 120 and 121. During this review over 1700 nonconformance documents were reviewed with over 200 problems documented. Closures of documented concerns are continuing.

Solid Rocket Booster (SRB) QE provided support to weekly Booster Separation Motors (BSM) Integrated Process Team meetings, providing input to the hardware Production Schedule, Qualification Schedule, and Status of open Vendor Problem Reports. QE continued to provide quality expertise to hardware failure investigations. QE supported the following project activities: the MSFC/USA SRB Element Weekly Engineering meeting, the SRB Chief Engineer's Problem Report meetings, and the USA-UPCO Weekly Pyrotechnic Working Group. QE provided core discipline review of SRB Pyrotechnic Hardware Vendor Problem Reports and SRB Elements Engineering Change Evaluations.

Space Shuttle Main Engine (SSME) QE participated in the investigation of contamination discovered on OV-104 Orbiter Main Propulsion System. Contamination was found at the pre-valve screen and was recurring with each inspection. SSME QE is working with MSFC and JSC personnel to develop a system logic probability study aimed at quantifying the risk to the engine due to a worst case contamination environment. Quality Engineering (QE) participated in several flowliner technical interchange meetings (TIM). Quality Engineering (QE) continued to support the flowliner crack investigation and test program. QE served on the SSME chief engineer's return to flight (RTF) CE-1 and CE-3 teams.

SSME QE proposed a plan to investigate the SSME design change implementation process for areas of improvement. The investigation is focused on developing tools to expedite changes which do not have a specific affectivity. The plan has been accepted and a paper review of the relevant procedures was completed. Interviews at Boeing-Rocketdyne with the process owners are underway.

After a review of the Level II change evaluation process, SSME QE has suggested and implemented a process where all future LCNs and RCNs reviewed by the SSME project be

reviewed by quality, system safety, and reliability. A change evaluation sheet will be submitted for each change from quality to configuration management, the SSME S&MA lead, and to the SSME project. SSME QE has established a folder named "Level II Changes" under the ECP directory on the U: drive to archive the change evaluations.

Reusable Solid Rocket Motor (RSRM) QE reviewed engineering change proposals, process change proposals, and Material Review Board items for quality and certification impact. RSRM Quality engineering has continued to act as the S&MA main point of contact for the RSRM Propellant Structural Analysis issues and pending waiver and for the recent liner bubbling issues. RSRM Quality Engineering also continues to lead weekly reviews of Thiokol's corrective actions. RSRM Quality Engineering is now acting as the Insulation Work Center S&MA main point of contact for issues in the RSRM Insulation Work Center.

HEI's QE QS20/QS40 personnel participated in the NASA Space Flight Workmanship Technical Committee and the QS20 Shuttle Integration Departments assessment of updates to Program Requirements.

#### **Software Quality Assurance (SQA)**

Software Quality Assurance (SQA) updated the Software Quality Assurance Plan for GLAST Burst Monitor, reviewed the Material Science Research Rack (MSRR) Software Configuration Management Plan, and reviewed the Software Requirements Specification Volume II. SQA witnessed MSRR Flight Software Loads, versions 2.6.2.2 and 2.6.3.3, on the Master Controller Ground Unit and the Glovebox Integrated Microgravity Isolation Technology (g-LIMIT) Flight Software loads including Formal Verification and Validation testing.

SQA attended the Systematic Software Testing training course presented by Software Quality Engineering (SQE) at the Marshall Institute, Software System Safety VITs classes from NASA Headquarters, and the 3<sup>rd</sup> Annual Southeastern Software Engineering Conference in Huntsville, AL.

SQA completed a gap analysis task on the conversion from SW-CMM to CMMI to help aid ED14 on their decision of the transition. SQA participated in the X-37 System Safety Working Group (SSWG) Meetings, Software Configuration Control Board (SCCB) Meetings and various In-Process Technical Review (IPTRs) in the review of documents and Software Problem Change Requests (SPCRs). SQA participated in a Safety Hazard TIM with Lockheed Martin. SQA participated in the AVGS Hardware/Software Development Status Review (DSR) and Technical Interchange Meeting (TIM) for the new ED14 project Orbital Express.

#### **ISO/AS9100**

Quality Engineering has continued to play a key role in ensuring the maintenance of ISO 9001 and AS9100 at MSFC during this time period. Efforts have dealt with continuing implementation of ISO 9001 and AS9100, maintenance of documentation (including the annual review of three documents and the revision of two), and planning and support for the NQA registrar audit, including preparation of self-assessment checklists for the MSFC organizations, escorting, development of corrective action plans, and follow-up and closure of corrective actions.

## **Payloads**

Quality Engineering (QE) performed drawing reviews, procedure reviews, test readiness review, and procurement reviews, inspection requirements, shipping requirements, and supported team meetings for MPLM, BiC, BRP, EGN, TES, OPCGA, Delta-L, ECLSS, QMI, SHIVA, GBM, MSRR, GP-B, Solar-B, MSG and GEDS.

QE reviewed and provided comments for safety verification closures for OPCGA, TES, Delta-L and ECLSS; provided quality expertise to Material Review Boards for ECLSS, MSRR, g-LIMIT and MSG; provided support for the Gravity Probe-B (GPB) Project by participating in a Flight Readiness Review (FRR); and, provided support for the Phase III Safety Review for the integrated Single Locker Thermal Enclosure System (STES) and Delta-L; as well as Delta-L integrated with the Microgravity Science Glovebox (MSG).

QE reviewed MSFC Custodianship Procedures, schedules and agendas for the MSRR MSL Engineering Model (EM) and participated in meetings and telecons held with ESA. Quality Engineering defined the documentation required for S&MA review and approval prior to the Custodianship Review held with ESA that is scheduled for April 2004. There are no open issues regarding this activity at this time.

QE reviewed and commented to submittals of the Acceptance Data Package (ADP) for the Wastewater Storage Tank Assembly (WSTA) book I & II for Environmental Control and Life Support (ECLSS).

Quality Engineering reviewed flex hose and Quick Disconnects (QDs) Acceptance Data Packages (ADP) and Qualification Test Reports (QTR) for Material Science Research Rack (MSRR).

QE continued to work to resolve the fastener issue for the Material Science Research Rack (MSRR) Project on the use of flight fasteners for the rack. S&MA will continue to work the problems associated with this until a complete resolution has been reached.

QE conducted a quality review of the SOLAR-B Extreme Ultraviolet Imaging Spectrometer (EIS) Acceptance Data Package ADP to determine if the Quality Assurance controls and documentation included in the Pre-Ship/ Acceptance package was adequate. ALERT responses, Transportation/Handling, Shipping Documentation, Nonconformance Reports, Waivers/Deviations, Material Review Board actions and Planned/Unplanned Open Items were reviewed. During the review with the Naval Research Laboratory (NRL), 11 discrepancies were noted by S&MA and submitted to the Project for resolution. S&MA will continue to monitor and verify closure of these issues.

QE reviewed Gravity Probe-B (GP-B) Acceptance Data Packages (ADP) at Stanford University in Palo Alto Ca, Lockheed Martin in Sunnyvale, Ca and Vandenberg Air Force Base (VAFB) in Lompoc, CA; reviewed the Problem Reporting and Corrective Action (PRACA) notification report for the anomalies that occurred during system level testing on the Water Processor Assembly (WPA) for Environmental Control and Life Support (ECLSS); continued to work with

the Teledyne Brown Engineering (TBE) Safety Engineer (SE) to resolve the GEDS Toxicity Assessment by the Johnson Space Center (JSC) toxicologist; QE worked with Multi-Purpose Logistics Module (MPLM) project team to close out the Acceptance Data Package for the Ground Support Equipment cables; and, supported the acceptance of the Habitat Holding Rack (HHR) Rack.

### **Inspection and Test**

Quality Engineer (QE) provided Test Area support providing for the reviewed and released procedures for the test facility build-up and the testing of the Northrop Grumman composite tank, the Advanced Fuel Project, and the build-up for cold flow hydrogen rig to support LAI investigation. QE also represented S&MA on the Test Readiness Review board for the Solar Thermal Testing at Test Stand 300.

Quality Assurance personnel monitored buildup and testing of the Multi-Element SCIT (staged combustion injector technology) motor, firings of the Solid Fuel Torch (SFT), and monitored transfer of Cryogenics in the east and west test areas.

QA personnel monitored vacuum baking procedures at the environmental test facility at Bldg. 4619. QA performed receiving inspection on various flight items at NASA quality office in Bldg. 4705. QA witnessed testing of various flight sub-Assemblies for programs such as Microgravity Science Glovebox (MSG), Material Science Research Rack (MSRR), Urine Processing Assembly (UPA), and Environmental Control and Life Support System (ECLSS).

### **4.4 Information Management (IM)**

Information Management (IM) developed several applications and incorporated significant revisions during the quarter. The first phase of the Internal Quality Audit (IQA) application was completed and demonstrated to the audit team. Significant manual database modifications were performed to transfer data from the system that was used to support audits previously. Requested application changes were incorporated and IQA has been deployed for beta testing. The Continuous Risk Management (CRM) web site was developed, reviewed, modified and deployed. Continual updates are incorporated. IM also completed the data entry portion of the CRM assessment tracking and reporting tool and released it to the customer. A SHE Training Checklist application was developed for the SHE Training Team. The application was demonstrated to the team, but deployment is pending modifications to associated processes. Significant modifications to the Inventory of Hazardous Operations (IHOPs) application were completed and the training module was revised. IM incorporated numerous revisions to the Safety, Health and Environmental Tracking (SHEtrak) application, including completion of initial requirements for the Environmental module. The module was demonstrated and requested changes are in work. The S&MA Travel application was revised to incorporate the QD organization structure and to provide expenditure tracking. The ALERTS email program was also revised to email only those persons who need to respond to the ALERTS. Numerous other modifications, such as revision of the Limited Vendor List (LVL), Safety Search and Supervisor Safety Web Page metrics charts were also incorporated.

IM met with Outsourcing Desktop INitiative (ODIN) server administrators to resolve issues with the Problem Reporting and Corrective Action (PRACA) server. IM determined the necessary

operating system and support procurement requirements for the replacement PRACA system and is working with system administrators to determine procurement responsibility and cost. IM also resolved several server administration problems. When an ODIN-supported server crashed due to hardware failures twice in one week, IM notified users of the problem and resulting data loss from several applications. IM also resolved several problems resulting from unintentional deletion by ODIN administrators of one S&MA application and one database, resulting in further data loss; users were again notified. IM also resolved many problems resulting from server administration activities that modified access privileges, and all privileges were reestablished. A problem with PRACA server administration that prevented Rocketdyne from submitting updates electronically was also resolved.

IM supported a telecon with NASA Headquarters representatives about potential funding for the S&MA Requirements Tracking (SMART) application. Proposals for funding were subsequently provided. IM also supported a cost analysis activity for the JIMO project to provide the SMART developer practical knowledge regarding the application of requirements throughout a project's lifecycle. SMART development and requirement gathering activities continued. IM completed S&MA's input to the yearly IT POP call and to a survey of IT seat classification that was required by AD32. IM provided support to development of capability for storing and searching Shuttle documents. IM representatives participated in training sessions, periodic telecons, an internal meeting, beta testing, and a meeting with application developers in support of the replacement NASA-wide Incident Reporting Information Reporting (IRIS) system. In addition, three Information management personnel completed two training courses in various aspects of developing applications using SQL Server 2000. IM also began providing periodic updates to S&MA management regarding the status of personnel completion of the yearly IT security training certification.

#### **4.5 Human Exploration and Development of Space (HEDS) Assurance**

IA personnel participated in the annual Conference on Quality in the Space and Defense Industries (QSDI) conference at Cape Canaveral, FL. IA personnel participated in the Code Q sponsored Quality Leadership Forum in Cocoa Beach.

##### **4.5.1 International Space Station (ISS) Independent Assurance**

Independent Assurance (IA) participated in a coordination telecon with KSC IA personnel to discuss the implementation of a "Shuttle, International Space Station and Payloads Independent Mission Readiness Assessment Plan" in support of STS 114. IA also participated in the Prelaunch Assessment Review for ISS mission 13P. No constraints to flight were identified.

IA reviewed Discrepancy Reports (DRs) from the Demonstration of Autonomous Rendezvous Technology (DART) contractor (Orbital Sciences Corporation) to evaluate contractor/project readiness for a Test Readiness Review and thermal vacuum testing, to assess technical rationale for disposition of DRs, and to assist the in-line S&MA in determining which DRs need further technical review. Verbal and written comments have been supplied to the customer that indicated there were no "show stoppers" that prohibited the review or test. The draft report of MH-4002 has been completed and sent to assessment team members for review. Team member comments

have been incorporated into the final draft report and the report was sent to the MSFC IA Manager for final review.

#### **4.5.2 Space Shuttle Independent Assurance**

The Independent Assessment Team held a meeting with the Solid Rocket Booster and Reusable Solid Rocket Motor management teams at MSFC to ensure projects' awareness of IA activities related to RTF.

The MSFC IA Team members participated in the SRB Separation Motor Igniter Redesign Critical Design Review. Project documentation was reviewed, and RIDs were written to document concerns. Primary areas of concern presented by the SRB project team dealt with Hazard Analysis/Fault Tree omissions and corrections; design parameters/analyses provided for review; and plans to remove and rework Booster Separation Motors (BSM) already installed in the SRB hardware. Areas of significant concern to be monitored by IA include the increased stress/strain present in components of the redesigned hardware and with "removal, modification, and re-installation" of hardware. Additional information will be provided to the Team as part of RID closure, and IA will follow project's activities to ensure that all concerns are properly addressed.

#### **4.5.3 Space Launch Initiative Independent Assurance**

IA supported the OSP/ELV Human Rating Certification Team as it outlined a roadmap on how the Program should proceed to develop a Crew Exploration Vehicle (formerly OSP) to be launched on an ELV. A final report has been prepared.

#### **4.6 Project Assurance**

NASA S&MA office was notified that a pronounced loss in peel strength was experienced in tests of the bond between ablation compound (RT455) and reformulated rubber (Silica Filled EPDM). The peel tests were generated in response to concerns over a significant loss of tensile adhesion strength exhibited in earlier testing. Both types of tests also resulted in a shift to adhesive failure modes. ATK Thiokol has cast propellant in one segment and has two other segments insulated using the reformulated Silica Filled EPDM rubber. Project Assurance will attend a meeting with all interested parties at MSFC has been scheduled to discuss the situation, future actions, and potential impacts.

HEI personnel met with a PDRM Consultant, on 01/23/04, to report on the progress QS20 has been making on the PDRM for Project Assurance. HEI reviewed the preliminary certification requirements. Also discussed were the training requirements the Shuttle Program is in the process of establishing for the Mission Management Team members. Once the training requirements are finalized by QS20 the PDRM for Project Assurance will be complete.

Project Assurance Engineering (PAE) supported the WSTF Facility CDR on 03-18-04. The review was conducted in preparation for the Aerojet Reaction Control Engine (RCE) test series, tentatively scheduled to begin in the summer of 2004. The test series will determine whether engines using non-toxic propellants (lox/ethanol in this instance) can provide safe, comparable, and/or superior performance to engines using more hazardous propellants such as hydrazine.

Project Assurance Engineering (PAE) reviewed Rocketdyne's monthly Nonconformance Summary Report which documents all RS-84 related IDCRs (Inspection Discrepancy Correction Reports). IDCR 2013096 was generated after post test inspections of the injector assembly revealed a missing, single element fuel post (subsequently recovered downstream of the pre-burner nozzle). Upon closer review of the IDCR, it was noted that pre-test, the post which subsequently failed was observed to be slightly bent at the root yet no documented evidence exists that any analysis was performed to verify the integrity of the post prior to testing. Subsequently, at start, the post experienced a high cycle fatigue (HCF) failure. Although preliminary the failure can most likely be attributed to a combination of LOX Chug which increased the post temperature and LOX flow swirl around the post tip causing the post to orbit or "whirl" at its first natural frequency. This "whirl" effect also induced high frequency alternating stresses at the root. A significant contributing cause was the bend in the root of the post. Since none of the posts are biased (intentionally bent to redirect propellants), the bent pin should have been flagged and testing delayed pending analysis. PAE will recommend that Rocketdyne conduct a structural analysis to develop accept/reject criteria in the event bent posts are discovered in the future.

Project Assurance Engineering (PAE), as part of the RMS Operability Team, has completed an exercise to examine the strengths and weaknesses of RS-84 S&MA activity for possible inclusion in the NASA Lessons Learned Database. Among the more significant observations/recommendations was Rocketdyne's high number of nonconformances, particularly at the vendor level, and subsequent need to impose more stringent formal controls of design and fabrication processes. Rocketdyne attributed a majority of the nonconformances to inexperienced vendors and the difficulty in manufacturing very complex hardware but, upon closer examination, it was discovered that many of those same vendors were successfully used on previous projects such as SSME. PAE submitted the following recommendations: 1) On future projects, Rocketdyne and its vendors should utilize more proof parts and Material Technology Demonstrators (MTDs) before beginning complex operations; 2) Discontinue the use of unreleased, 7R, drawings in manufacturing operations; 3) Identify all critical processes and assure that requirements are adequately flowed down to each vendor; and, 4) Perform periodic process and procurement audits.

Project Assurance Engineering (PAE) continued to provide support for NGLT Projects (ISTAR, RS-84, TR-107, Aerojet RCE Project, and IPD) reviewing and approving 20 contract deliverables during the reporting period. PAE also performed closeout activity, compiling inputs from the ISTAR, RS-84 and TR-107 Projects for inclusion in the NASA Lessons Learned Database. PAE provided S&MA support/input to resolve welding, proof test and NDE issues related to the IPD Project. PAE also worked and Completed 1 action item in Support of the Shuttle Derived Requirements Study Team

Project Assurance and Reliability Engineering have submitted the current Shuttle Propulsion Elements Reliability numbers to close an action assigned to the Shuttle Derived Requirements Study Team. The information was placed in a secure database and will be used to provide the Launch Vehicle Study Teams with a common set of data from which to derive top level reliability data.

Project Assurance Engineering developed a list of Safety & Mission Assurance concerns in response to the Columbia Accident Investigation Board (CAIB) review – Working with the Safety & Mission Assurance Panel, assisted in developing a list of issues that were identified as key concerns directly related to the CAIB report. This list was to be further developed into S&MA goals and objectives for improving the methods and procedures in accomplishing S&MA policies.

ET Project Assurance performed a risk assessment on a potential LH2 / Intertank Flange enhancement. The potential enhancement has been termed as “point fill”. This enhancement is a mitigation effort against cohesive thermal protection system (TPS) failure and debris. The purpose of point fill is to prevent nitrogen intrusion from the intertank purge system into voids in the external metallic substrate and the TPS closeout on the flange. The point fill is an application on external gaps and joints of the flange metallic substrate prior to the application of the TPS closeout. Project Assurance identified numerous concerns that require additional development of acceptance rationale and mitigation. These concerns include TPS contamination, material compatibility, acceptance verification requirements, and identification of critical process parameters, material characterization, and vendor control. ET Project Assurance recommended further development of point fill candidates. ET Project Assurance will continue to evaluate the point fill enhancement throughout development and assure that all open concerns are mitigated.

ET Project Assurance (PA) participated in an ET LH2 Tank / Intertank Flange Technical Interchange Meeting (TIM) at the Michoud Assembly Facility. The objectives of the TIM was to establish the adequacy of the Intertank Flange Enhancement with respect to the requirements, provide an educational insight to the existing issues and potential resolutions, and evaluate the adequacy of the verification and certification approach. ET PA presented S&MA’s roles and responsibilities in the flange enhancement effort. ET PA also presented the fault tree analysis for thermal protection system (TPS) loss in this region of the ET. Concerns and recommendations for risk reduction were also presented by ET PA. Approximately 60 action items were recorded at the TIM, most of which echoed ET PA concerns that were presented. ET PA will continue to engage in the LH2 / intertank flange enhancement effort and assure that all risk concerns are properly mitigated.

ET Project Assurance identified an indictment of a current baselined ET hazard report, S01 – Excessive Stress in the Intertank. The baselined hazard report cites a thermal analysis that demonstrates 2.8-inches of frozen nitrogen in the liquid hydrogen (LH2) tank and intertank internal y-joint. A subsequent structural analysis demonstrated no resulting structural damage to the ET. Recent return-to-flight testing and analysis has demonstrated that the level of frozen nitrogen in the y-joint is in excess of 4-inches. This data indicts both the baselined structural analysis and the current hazard report. ET Project Assurance will continue pursue an updated structural analysis to assure that structural margins are maintained on the intertank. ET Project Assurance will also assure that updated acceptance rationale is reflected in the updated hazard report.

Project Assurance Engineer (PAE) attended a Space Systems class, prepared by Applied Technology Institute, in Baltimore MD. Although majority of topics centered on the science of satellites and their needs in deep space, the ground ops, propulsion, thermal and trajectory

calculations are definitely applicable for travel to solar planets, as is intended with the Crew Exploration Vehicle. In addition, PAE is participating in preparing white papers, information that NASA Headquarters may use as lessons learned, on three key topics: (1) Lessons learned from Apollo, (2) OSP Minimal Functionality List, PAE is the lead engineer on this white paper which decomposes the OSP System into a functional list without coupling or omissions, and (3) SP6105, NASA Systems Engineering Handbook Vs OSP Systems Design Requirements (SDR) and Preliminary Design Requirements (PDR) Design Requirements Descriptions (DRD)s, this white paper uses the OSP deliverables as lessons learned to identify the actual DRD's required. HEI's Project Assurance Engineering (PAE) is participating in the OSP 90-day contract Proposal evaluation from Boeing's Phantom Works in Huntington Beach, CA. The 90-day contract extension requests Lessons Learned from the contractor and runs March 04 thru May 04. PAE is evaluating the resources that are proposed to be employed in developing lessons learned in the Safety and Mission Assurance areas of the contractor's Statement of Work.

The Product Assurance Engineer (PSE) developed the Technology Flight Demonstrations (TFD) Subproject Risk Management Plan, NGLT-TFD-0016, and the Subproject Safety & Mission Assurance Plan, NGLT-TFD-0017. Both plans were baselined at the HyTex Project Control Board (PCB). The Product Assurance Engineer (PSE) produced a Preliminary Hazard Analysis report, and a Risk Analysis report, as RID-able documents for the HyTex POC Mission PDR. The PSE produced top level briefing charts for the HyTex PDR. The PSE reviewed documents, wrote RIDS, attended all the presentations, supported the review teams to disposition RIDS, and supported the Preboard.

The PSE produced a Preliminary Hazard Analysis (PHA) for the Jupiter Icy Moon Orbiter (JIMO) refuel study. The study team was analyzing four different options to refuel JIMO on-orbit. The PSE recommended two additional options and generated PHA for all six focusing on hazards unique to each option. The PHE participated in the refuel study meeting discussions about the pros and cons of each option. Of two remaining options, one is one of the PSE suggested options.

The PSE initiated an exploration into the prospects for hazard and reliability analysis tools to support real-time concurrent conceptual engineering. This new wave of engineering practice is already employed by the PARSEC and Lunar Surface Power teams. Most participants have been writing their own code to interface with a common database where they share data with other team members on a real time basis. Meetings consist of members assembling around a table, each with their own laptop. The iterate designs in ten to fifteen minute cycles.

Project Assurance for Boeing Architecture has continued to lead the S&MA activities on the Boeing OSP Project during the reporting quarter. This involves project staff meetings, weekly contractor telecons, and program meetings and forums. The more significant project activities during the reporting period involved: 1) participation and S&MA lead activities in the project's Systems Definition Review followed by the associated documentation review and SDR pre-board activities; 2) Participation in the contractor's Lessons Learned kick-off and technical interchange meetings at Huntington Beach, CA.; 3) participation in the governments OSP Lessons Learned development activities; and 4) participation in the 90-day OSP contract extension technical evaluation activities.

PAE personnel have participated in two launch simulations during this period. PAE provided console support at the HOSC and followed all issues. Information regarding simulated anomalies was provided by PAE to the MSFC S&MA Integration representative.

Project Assurance (PA) personnel participated in a MSFC Shuttle S&MA off-site meeting that included the MSFC S&MA Director, his team leads, the senior RMOs and DCMA leads along with the HEI PAs. All facets of S&MA responsibility were discussed, along with organization goals, teamwork priorities and best practices from all elements.

#### **4.7 Risk Management and Risk Assessment**

##### **4.7.1 Risk Management**

HEI Risk Management Project Assurance Engineering (PAE) provided one half day of Continuous Risk Management (CRM) training to the SPD Project. There were 10 participants in the class and additional students were tied in via teleconference from a number of universities around the country. The participants were introduced to the CRM practice with an emphasis on capturing risk statements.

HEI CRM PAE provided a one half day presentation of CRM with a risk writing workshop to the g-LIMIT Project. There were 9 participants in the class. The participants were introduced to the CRM practice with an emphasis on capturing risk statements. During the workshop PA worked with the team they examined the risks of the project that have already been captured in the ePORT risk reporting databases and clarified the risk statements and mitigation strategies and reassessed the likelihood and consequence of the risk. A follow-on workshop is planned to go through the risk identification process again as the program enters its final stages.

HEI CRM PAE participated in the development of the new QS40 Continuous Risk Management website. The site is up and running and can now be found through a link on the Inside Marshall webpage.

HEI CRM PAE developed a risk closure process to support the closeout of risks documented in the OSP program risk data-base. PAE is working to assist the program in capturing lessons learned over the life of the program and document those lessons in the database.

HEI CRM Project Assurance Engineering (PAE) developed a draft version of the Integrated Risk Management Application (IRMA) Users handbook. This was developed to address CRM training needs. The effort was initially undertaken prior to the shutdown of the OSP program and was seen as another training tool that would be beneficial to the OSP CRM training effort. It will also benefit the user needs of the other potential users of the IRMA tool.

The IRMA development team has developed an IRMA Administrator's Guide for database administrators. The review included: the process for establishing user identification and password generation, program/project hierarchy and tier structure, data error reporting, graphical representation of risks and risk data reports unique to the project or program. Process flow and documentation errors were noted and suggested corrections were annotated to the document and then forwarded to the IRMA database developer.

To establish a better understanding of available CRM tools, an ePORT training overview was provided by the MSFC SMO office by RM. This overview provided insight and understanding on using the ePORT tool to support the CRM education effort for small and medium projects located at MSFC.

#### **4.7.2 Space Shuttle Probabilistic Risk Assessment (PRA)**

Risk Assessment (RA) continued to support the Shuttle Probabilistic Risk Assessment (PRA) activities, including review of the PRA Independent Peer Review (IPR) reports, coordination of responses from MSFC PRA team members, review of Code Q comments and recommended changes, and development of proposed actions to address PRA deficiencies identified by the IPR. RA participated in a Shuttle PRA Technical Interchange Meeting (TIM) at JSC with the PRA analysts, representatives from Code Q, and the Independent Peer Review Panel to develop specific task plans for changes to the current Shuttle PRA models. Several Shuttle PRA subtask teams convened in Rockville, MD with representatives of the IPR panel and Code Q to address specific subtask issues. Additionally, RA was requested to support the NASA Engineering and Safety Center (NESC) Independent Technical Assessment (ITA) of the cracks in the Orbiter LH2 feedline flowliners. RA assisted in the development of a preliminary PRA that was sent to the NESC team for comments and is also providing support in the area of event tree and fault tree development and modeling.

#### **4.7.3 Reliability Prediction & Risk Analysis**

RA is extensively involved in a number of Shuttle RTF activities, primarily by providing statistical data analysis support, and has traveled frequently to MAF to maintain close coordination with the ET team. RA prepared a presentation regarding statistical characterization of foam voids found during dissection of ET-94 and -123 Protuberance Aerodynamic Load (PAL) Ramps that will serve as a benchmark for ET PAL ramp void data and to help understand and eliminate causes of the voids. Another analysis was presented regarding ice loss from the ET ice bellows from historical imagery. RA worked closely with the SRB ET Attach Ring/ Splice Plate team to help characterize the fracture toughness of the existing rings and splice plates based on test data, and to help design a test to develop a calibration curve for new portable hardness testers. In addition, RA characterized Attach Ring fracture toughness data and suggested lower bounds for the structures. RA supported the SRB Separation Bolt/ Bolt Catcher re-qualification/ redesign effort by designing test plans and analyzing data, resulting in a recommendation for a maximum velocity for bolts. RA also provided support to the Main Propulsion System (MPS) pre-valve contamination issue, including development of a logic tree representing plausible contamination scenarios to help understand the risk of a catastrophic event/failure to the system.

#### **4.7.4 OSP Risk Assessment**

In support of the OSP program, RA continued development and coordination of an OSP RMS White Paper to ensure all NASA participants and the vehicle contractors share a common understanding of the various OSP quantitative RMS parameters, and to provide a consistent framework in which the vehicle contractors can base their RMS analyses. RA participated in the OSP contractor SDRs and reviewed and provided feedback on the various RMS deliverables. RA continued to lead the OSP PRA working group to plan and coordinate OSP PRA activities with multiple NASA centers and contractors. Since the termination of the OSP program, RA has

participated in the ongoing lessons learned effort to ensure that PRA related lessons learned that will be of benefit to future programs are appropriately captured.

## **5.0 COST REDUCTION ITEMS**

Our continuing cross-utilization of employees, continuous analysis of work in progress to assure that application of resources meets the needs of the task, and the judicious acquisition and distribution of tools to enhance the efficiency of all team members allow us to minimize cost to the customer.